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A NEW ROLE FOR ICEBERGS

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A NEW ROLE FOR ICEBERGS

Kevin J. Quinn*

FOREWORD

Certain facets of iceberg utilization could provide the story line for a modern fairy tale wherein a wealthy prince proposes to use a modern alchemy (economics) to transform one substance into another--in this case, to turn oil (revenues) into water.

There have always been areas that needed water, but only rarely have logistics, technology, and economics combined to translate this passive "need" into an active, effective "demand" supported by the means to achieve its satisfaction. (Consider the aqueducts of ancient Rome and contemporary California; most of the easy interbasin transfers have already been made.) A rigorous economic analysis of this idea is beyond the intent of this paper; it is also unnecessary, for even a superficial inquiry soon discloses that most of the very recent interest in iceberg transport is heavily based on the clear intimations of Saudi Arabia's Prince Mohammed Al-Faisal that, "We can afford it."¹ Not everyone is so certain, nor as financially secure, yet the Prince has many years' experience with his country's Saline Water Conversion Corporation, a \$15 billion operation, and speaks with some credibility.

Whatever is learned from preparation and execution of the first full-scale iceberg utilization venture could conceivably be also applied to other areas of the world which have similar needs, and comparable assets, but less initiative in this field. This paper will proceed in two parts: first, it will describe the emerging geographic qualities and attributes with which other world regions could most directly apply the practice of obtaining icebergs as a source of fresh water and other benefits, using our current knowledge of the situation. Second, it will examine the undecided nature of international law governing the ownership and transfer of icebergs.

Initially, the discussion will deal with the characteristics of the iceberg resources available, then project the desirable attributes of a compatible destination. It is hoped that this exercise will help alert those concerned that icebergs could, and should, be of more interest to them.

Several basic assumptions and limitations should first be stated. The intent of Part I is to use a geographical perspective, i.e., relating societal and natural features in a spatial way. It is exceedingly difficult to define the socio-geographic limits of a state-of-the-art technological

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operation. Therefore, only some of the major navigational and engineering parameters which interact with geography will be discussed.

Present studies have concluded that towing Antarctic icebergs to arid regions is technically feasible and can provide large quantities of fresh water at costs significantly lower than capital and/or energy-intensive alternate processes such as overland conveyance or seawater desalination.²

Several icebergs have already been moved short distances by offshore oil rig operators³ and the U.S. Coast Guard while laboring under constraints which minimized scientific data gathering. Thus, it can be done; the remaining questions are merely extrapolatory--how big, how far, how long, and at what costs. Detail refinements await future attention to maximize efficiency and to tailor this demonstrated capability so as to fit specific cases.

In Part II of this paper, the unsettled nature of international law regarding the acquisition and transport of Antarctic icebergs will be addressed. Citations of relevant treaties and customary practices will be interspersed with appeals to general principles and the writings of learned jurists so as to give an overall picture of the current status of such operations.

The major thrust, however, will be to point out some of the multitudinous problems that will have to be faced and resolved if ever we are to be able to say that icebergs have been fully assimilated into the protection and practice of international law.

INTRODUCTION

Icebergs have had a "bad press" in this century, generally being considered as implacably evil and treacherous, worse than useless, and actually dangerous. This reputation was pointedly solidified in the minds of the public when the SS Titanic collided with an iceberg and sank in April of 1912.⁴ Despite this past notoriety, icebergs are rapidly becoming an attractive resource of vast potential--"frozen assets" is the irresistible pun--as new technologies develop in response to a growing need for more efficient exploitation of our global water supply.

Only 2-3% of the earth's water is fresh (non-saline),⁵ and over 80% of this fresh water is ice.⁶ Most of the liquid fresh water is already in use, but there is no shortage of ice. The amount of fresh water stored as ice in the polar regions is vast, about 2.8×10^{10} kg; this is equivalent to more than a 200-year supply of rainfall over the earth's entire land surface, about 1.1×10^8 kg/yr.⁷

The economic use of ice meltwater is not new either in theory or in practice. To quote one author, "One is hard put to imagine a ship-load of Vikings returning home from a summer's foray twelve centuries ago refusing a goblet of cold meltwater from a chanced-upon berglet."⁸ In January of 1773, the English explorer Captain James Cook recorded in his diary that he took on board 15 tons of fresh water from icebergs found floating in the Antarctic region and he termed this procedure "a most expeditious way of watering."⁹ Even as recently as the late 1800's, small icebergs were both sailed and towed up the western coast of South America as far north as Callao, above Lima, Peru, and there used as a refrigerant and as a water source.¹⁰

Conceptually, icebergs could be floated to any point accessible by a deep water route. For water-scarce areas of the world, the possibility of using icebergs as a fresh-water resource becomes an especially attractive prospect when alternate sources are exceedingly expensive, if they are even available at all.

Attributes of Icebergs

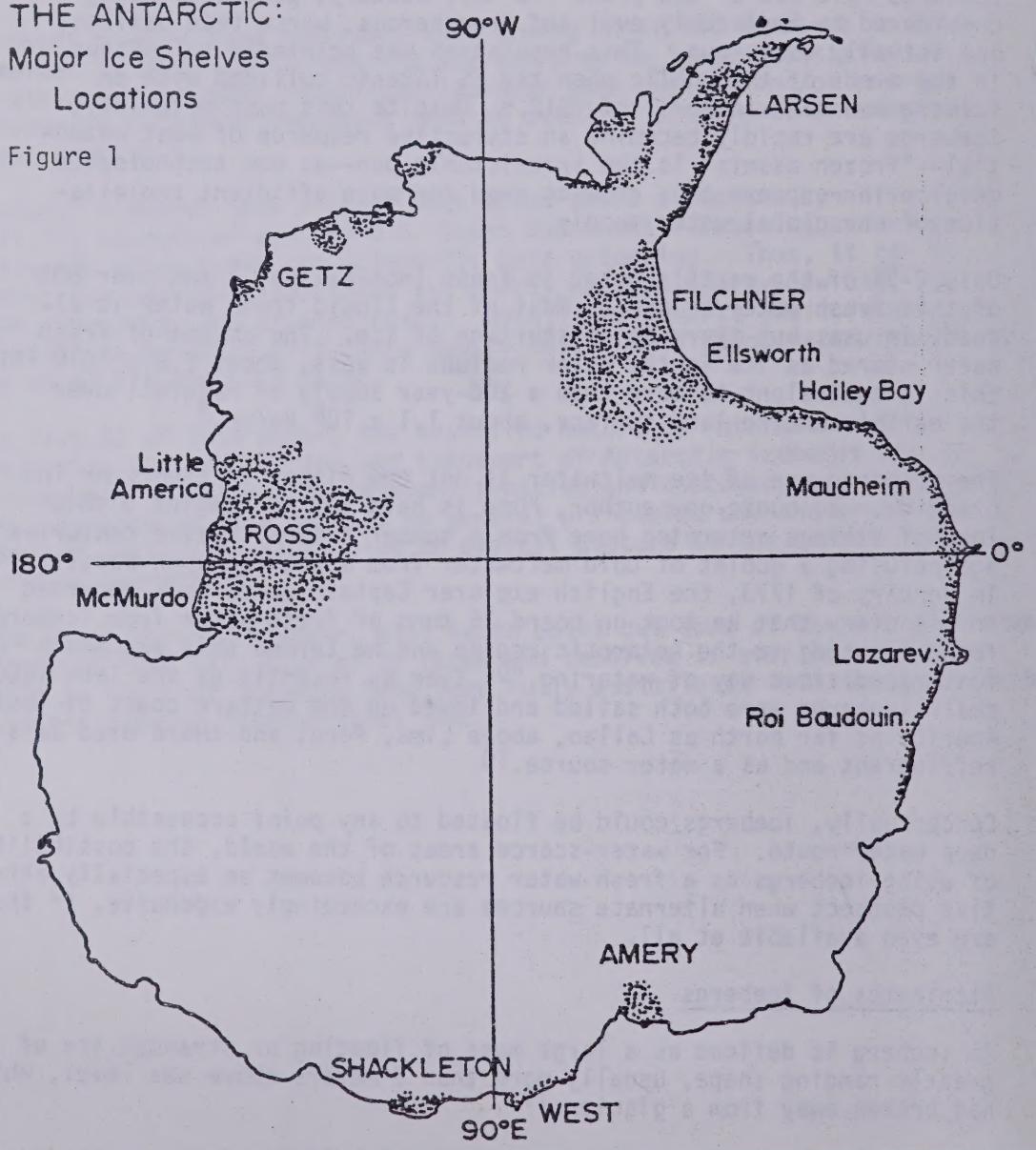
An iceberg is defined as a large mass of floating or stranded ice of greatly ranging shape, usually more than 5 meters above sea level, which has broken away from a glacier.¹¹

Both polar regions produce such icebergs, but those of the north are neither as common, as large, as well-shaped, nor as accessible as their southern counterparts.¹²

The prime sources of large, stable, tabular-shaped icebergs, which are best for towing, are the great floating ice shelves of Antarctica.¹³ (See Fig. 1). Where the shelves attached to land, they are fed by huge

THE ANTARCTIC:
Major Ice Shelves
Locations

Figure 1



glacial discharges, yet the predominant input is the accumulation and compaction of snow on their upper surfaces.¹⁴ Some frozen sea water may occasionally adhere to the base of an ice shelf,¹⁵ but by far the overwhelming mass is derived directly from precipitation and is, thus, fresh water, usually of exceptional purity.¹⁶

In contradistinction, frozen sea water commonly forms solid "pack ice" about 1-2 meters thick during each winter season, only to melt again in the polar summer.

Estimates of overall annual Antarctic iceberg production are on the order of 10^{12} m^3 , or 10^3 km^3 ,¹⁷ which is about equal to the input. Even if only 10% of this volume could be delivered intact, it could irrigate 15 to 25 million acres of land.¹⁸

A total thickness of 200m (about 650 feet) is commonly found near the edge of the ice shelves. Of this, only about 50m floats above sea level, leaving, therefore, an initial draft of about 150m.¹⁹ This deep draft is a major navigational concern; it makes the iceberg susceptible to deep currents and obstacles which would not concern operators of a normal sea-going vessel.

The actual process and causes of an iceberg's separation, or "calving," from its parent ice shelf are not well understood, but this calving is considered to be a reasonably continuous process on an annual time scale.²⁰ One very large iceberg which calved from the Princess Maude coast in March 1967, measured 45 by 85 km, which is only slightly smaller than the entire state of Rhode Island, and contained approximately 2.3×10^{14} gallons of water.²¹ Even this was not the largest; others have measured 45 x 140 km, the first two of which drifted intact for over 6 years and traveled about 4,000 km along the Antarctic coast.²²

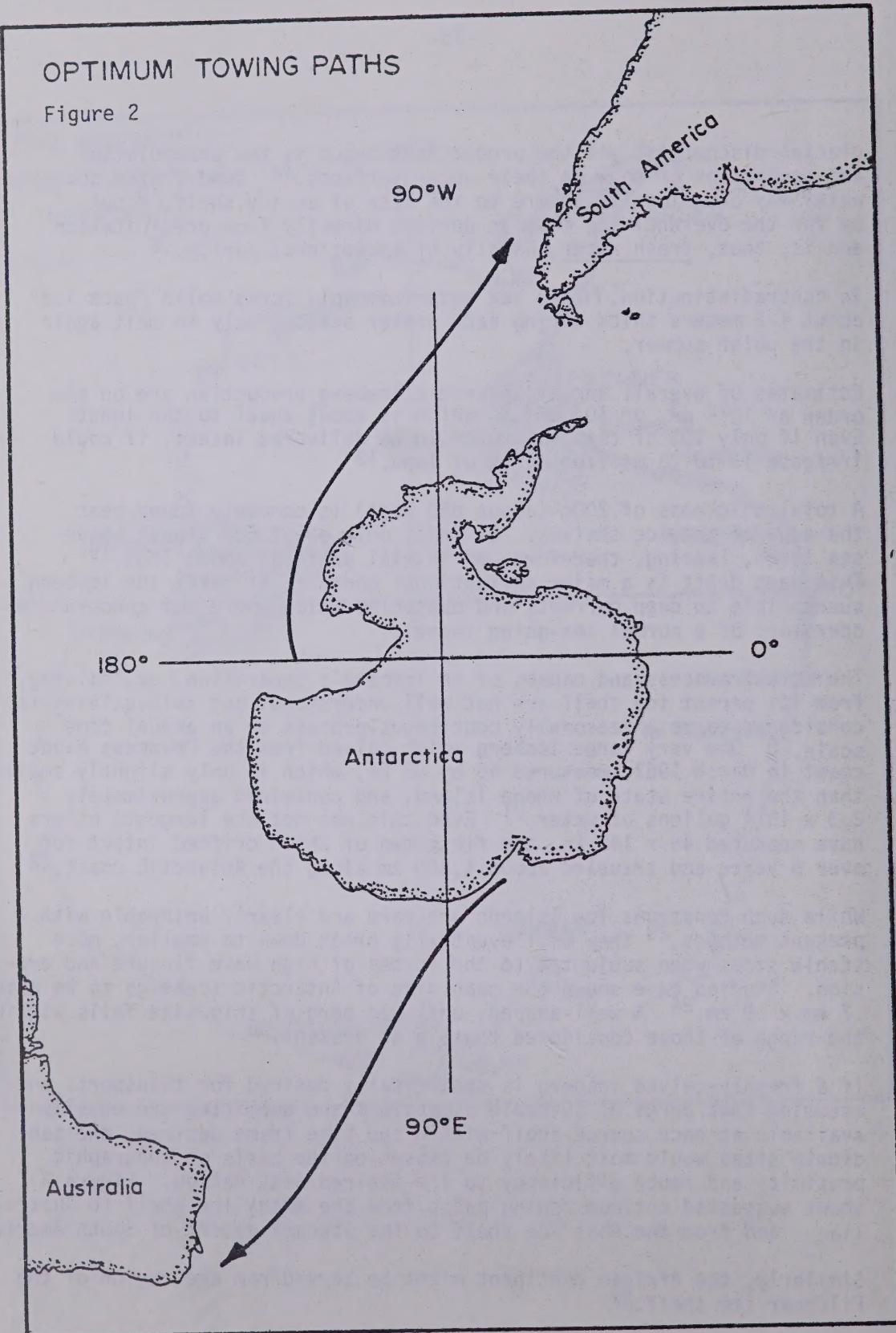
While such monstrous ice islands are rare and clearly untowable with present methods,²³ they will eventually break down to smaller, more stable sizes when subjected to the forces of high wave flexure and erosion. Studies have shown the mean size of Antarctic icebergs to be about .7 km x .9 km.²⁴ A well-shaped, unflawed berg of this size falls within the range of those considered towable at present.²⁵

If a freshly-calved iceberg is specifically desired for transport, and assuming that bergs of suitable dimensions and qualities are equally available at each source-shelf within the time frame desired, the candidate sites would most likely be chosen on the basis of geographic proximity and route efficiency to the desired destination. Figure 2 shows suggested optimum towing paths from the Amery ice shelf to Australia, and from the Ross ice shelf to the Atacama desert of South America.

Similarly, the African continent might be served from the region of the Filchner ice shelf.²⁷

OPTIMUM TOWING PATHS

Figure 2



Seasonally heavy concentrations of pack ice, however, may be a serious hindrance to acquisition of bergs directly from their source shelves.²⁸ Legal and political objections to this procedure may also arise from the nations signatory to the Antarctic Treaty of 1959,²⁹ which we will discuss in a later section.

Another option exists for acquisition, that of obtaining an older free-floating berg which may have experienced some erosion but has already drifted away from Antarctica by natural processes. Some consideration of southern ocean current patterns becomes appropriate at this point.

Near the Antarctic coast, the Eastwind Drift Current circulates young icebergs in a westward flow around the continent. Two large clockwise gyres occur in the Ross and Weddle seas and several smaller gyres appear along the coast of East Antarctica, particularly near 90°E. These gyres give rise to spiral-like patterns of iceberg concentrations. Further to the north, the currents diverge, converge, and change direction, settling into a generally eastward flow with a slight northward drift.³⁰ Icebergs tend to follow the general surface current pattern as described above, but with high variability, based partially on wind effect, Coriolis effect, and subsurface currents about which little is known.³¹

In terms of general latitudinal distribution, iceberg sightings are said to be common as far north as 40°S in the South Atlantic and Indian Oceans and to 50°S in the South Pacific Ocean, although concentrations are much higher and more uniform south of 65°S.³² By this latitude, no significant distributional variation with longitude exists.³³

Normal vessel traffic in sea lanes are regularly warned of the presence of large, slowly moving icebergs. This warning mechanism, and perhaps others, should be applied even to icebergs in transit under man's power, for they would still be ponderous and slow, moving at speeds between .25 and 1.0 knot in order to reduce wasteful drag and turbulent ablation.³⁴ For a "typical" surface-towed iceberg of 200m x 160m, with a suitable propulsion system, calculations show that it would take 5 hours to accelerate from a stop to a speed of 1 knot, and would require 22 hours to decelerate the same berg with the same tug to a speed of .1 knot. Thus, even small corrections in course headings would consume a full day's time.³⁵

The most well-developed iceberg towing proposal extant would take a floating berg of 200 million metric tons from 65°S and 25°E to the Saudi Arabian port of Jeddah on the Red Sea at a speed of about 1 knot over a distance of 6,325 miles in 39 weeks,³⁶ and that rate of transport includes detailed allowances for currents, gyres, winds and weather, even utilizing the monsoonal reversal of winds to help it on its way.

One final attribute of icebergs that could be important, yet is seldom mentioned, is that they are not only merely frozen, they also have a significant "cold reserve," i.e., an internal temperature well below the freezing point of water (0°C.), which remains with them practically until the last chunk of ice is finally melted.³⁷ These thermal values can range from -18°C. to -27°C.³⁸ and constitute an additional "heat sink" potential which, in consideration of the volume of ice affected, could have industrial and processing significance well beyond the importance of the basic water resource in the iceberg itself.³⁹ One researcher has calculated that the energy required to transport a typical Antarctic iceberg to California is that equivalent to lifting the berg a vertical distance of 10-20 meters, but the energy required to melt that same berg is equivalent to lifting it 43 kilometers.⁴⁰ The implications of this aspect will be discussed more fully in a later section.

So far, we have seen that icebergs are abundant, clean, large, and cold, all of which are highly desirable qualities for our purpose. Unfortunately, icebergs are also remote, unstable, unwieldy, of uncertain legal status, and largely untried. Let us now try to project from these qualities and determine the most desirable attributes of a hypothetical destination which is compatible with time.

Attributes of a Destination

Who would want an iceberg badly enough to get one? That would be someone who has a great need for what icebergs can do, who thinks he can get it from icebergs at lesser costs than from other sources available to him, and who would be able to utilize a berg effectively for his purposes.

In this section, these three aspects will be examined: high need, competitive costs, and exploitability.

A high level of continuing need, both qualitatively and quantitatively, for iceberg-derivable products and services, must be the first measure applied to a potential destination. We shall use the example of a fresh water need, but it is understood that other aspects of icebergs are also amenable to such an analysis, e.g., "heat sink." The need for a high volume of fresh water is necessary in order to approach the economies of scale that are possible with icebergs, and to assure that local alternate sources of water, which may be easily overlooked by those with a global perspective, will not be significant enough to intrude in the future to offer unanticipated intramarket competition. Cooperative arrangements on a regional scale might be used to "pool" the needs of several adjacent locales with individual needs too small to enjoy separate status as iceberg destinations, but such a region would have to be compact enough to minimize landward processing, transportation, distribution, and administrative factors (hereinafter termed infrastructure) which could run substantially higher costs than the "seaward" costs of iceberg capture and transport.⁴¹

The need should also be regular, that is, reliably predictable, seasonal if not continuous. This is desirable in order to achieve maximum efficient utilization of the capital investments as well as to facilitate scheduling deliveries timely to local needs. Scheduling lead times of up to two years have been predicted.⁴² The existence of large-scale off-berg storage facilities does not appear to be entirely satisfactory in compensating for an irregular demand. Storage facilities would not only represent an additional capital investment "up front," but would also conduct losses of the initial investment in the iceberg, via longer susceptibility to evaporation, pollution, even sabotage during storage, in addition to a likely loss of the thermal absorptive capacity over time.

Let us direct our attention now to the competitive aspects of iceberg utilization costs, and quickly move beyond the unique novelty appeals likely to be associated with souvenir promotions, etc., for the first successful pilot project.

The first regular usage of iceberg qualities would most probably be for necessities and other high value uses which would be able to attract and sustain the venture capital needed. Such uses might include direct human consumption of potable water, unique industrial services, or even political aggrandizement, all of which purposes, and others, will depend on socio-economic values specific to the destination.

Note that agricultural irrigation is generally considered a low-value, inefficient use of high-quality water unless the cultivation is unique or intensively capitalized, e.g., drip irrigation in greenhouses; nevertheless, the psycho-political appeal of food production can become erratically high.

Simultaneous application of the aforesaid requirements of a high volume need and high value uses inexorably narrows the range of likely iceberg-transport destinations to such places as thirsty population centers, luxury agricultural regions, and/or industrial complexes.* Of these, the mobility of industry is clearly great enough in most cases so that it can afford to be conservative, locating itself to suit the resources, rather than the reverse, and thus industry is more likely to let the risks inherent in new ventures be borne by the desperate, those necessarily committed to obtaining water by importation.

As a further exercise in reductionism, we shall observe that luxury agricultural regions are seldom found at great distances from population centers but, rather, are often closely associated with them, even enjoying a cause-effect relationship with them. Thus, we may focus our attentions on population centers--cities and metropolitan regions whose internal and hinterland development requires regular infusions of large volumes of fresh water in order to achieve pressing local imperatives.

*Certain other unusual situations might also qualify, such as weather modification to prevent hurricane damage, but these are likely to be rare and/or mobile.

In contrast to a site with potential industrial or agricultural capabilities, an existing population center would, of necessity, already have some form of water supply infrastructure in place and operating, and would likely utilize additional inputs of fresh water from icebergs as a supplement to the existing sources, perhaps even supplanting any unsatisfactory or more expensive supplies than in use. Such an arrangement would expedite utilization and evaluation of the iceberg resource.

An additional benefit of delivering an iceberg to an existing city is the possibility of realizing the synergistic effects of sequential and simultaneous uses, without risking additional capital investments in advance. For example, waste heat from a power plant could be used to help melt a delivered iceberg while simultaneously ameliorating the environmental impact to the receiving marine waters of both the previous hot thermal effluents of the power plant and the cold thermal impacts of the iceberg at its mooring. A further symbiotic sequence might involve air conditioning, human consumption, industrial washing, and eventual irrigation of agricultural lands. Other steps might be added, or the order of use in the sequence might be changed, but the basic idea here is that an existing city offers several built-in ancillary markets for using iceberg-derived services without the need for further investment of costly venture capital.

How are we to distinguish degrees of destinational desirability among multiple-thirst population centers? By applying our third criterion, ease of exploitability and utilization. This desirable attribute is more complex than our earlier ones, and encompasses physical, technical and social factors and abilities.

Physical exploitability is taken to mean that combination of topographical features and processes which is compatible with the requirements for efficient utilization imposed by the characteristics of icebergs and their transport systems. Considering the present state-of-the-art, this translates to mean that a good destination will be located along an accessible seacoast with a narrow continental shelf, with deep and sheltered harbors, and favorably directed cold currents. Naturally, an ideal location would also be near the iceberg's source, preferably in the Southern Hemisphere.

For technical exploitability, our target destination should be an area which is already "developed" enough, or advancing rapidly enough, to have access to an efficient infrastructure for water supply management, construction, and distribution, as well as an ability to create and apply innovative procedures and structural systems so as to maximize efficient utilization of an iceberg delivery system and minimize any undesirable aspects that may appear in connection with the venture.

Social exploitability is by far the most complex attribute of a desirable destination for iceberg transport. Financial maturity and political stability are necessary if a region is to be able to afford the luxury

of occasionally looking beyond its own borders for solutions to its internal aspirations. Regardless of economic value, any proposal for iceberg utilization will need some political currency, for the fields of water supply and development have traditionally been of great concern to governmental regulators. In order to assure some measure of governmental acquiescence, if not active support, the project's proponents must present an image of innovative leadership rather than one of impulsive desperation. Both old and new types of socio-legal complications can arise in a venture of this sort, and the first few iceberg users will need the international standing, protection, and advocacy which official governmental support can give.

All of this is just another way of saying that the domestic impacts of successful iceberg utilization will involve the relatively easy task of allocating a perceived "good," whereas the international scene could involve defending a procedure possibly perceived as being inequitably exploitative of various sovereign claims and the "common heritage of mankind." At this point, the very basic question of access to the resource is at stake.

Here the question may be asked: Who can legitimately authorize or prohibit the use of the iceberg resources of Antarctic? The question is certainly clear, but the answer is clearly uncertain.

"...[T]he legitimacy of claims to Antarctic Ocean basin icebergs is inextricably intertwined with the legal status of glacia firma Antarctica ... [which] is very much an unresolved question."⁴³

Anyone may claim an iceberg floating freely on the high seas north of the boundary limits of the Antarctic Treaty (60°S.).⁴⁴ If a prospective user-state's social exploitability skills are used effectively, it is conceivable that one or more of the seven states claiming sovereignty over various sectors of the Antarctic continent could be induced to grant permission for removal of icebergs from that sector's territorial seas and/or 200-mile Exclusive Economic Zone, such as they may be.

The surest way for an iceberg user-state to maintain political access to Antarctic icebergs is for it to be--or become, if that is possible--a claimant party to the Antarctic Treaty. Then the full range of types of Antarctic iceberg sources, from landward glaciers and through coastal ice shelves, extraterritorial zones, and high seas would be available.

To recapitulate what we have seen in this section, a good destination for an iceberg transport and utilization project should have:

- a high level of need,
- high value uses, and
- high capabilities for physical, technical, and social exploitation of icebergs.

These attributes were deemed most likely to be found in a modern growing population center situated on a deep seacoast in the southern hemisphere.

All of these thoughts, of course, are offered only in the context of the limitations of present knowledge and capabilities. As experience is gained with the use of icebergs and in particular with the degree of reliability that may or may not be associated with their use, we may eventually see entire industrial complexes and even regional systems being designed from the start so as to take maximum advantage of the unique properties of icebergs. Only then can it be said that icebergs have truly "arrived."

International Legal Aspects of Iceberg Utilization

Although the scientists and engineers seem ready to proceed immediately, at least on a pilot project, their financial and political backers are understandably hesitant to commit themselves to a venture of such magnitude without the assurance of substantial and decisive legal protection.⁴⁵

To illustrate the complexities of an iceberg's legal status, let us take a relatively simple case first--one in which a governmental vessel finds a small iceberg floating on the high seas near its coast, takes it in possession, and successfully tows it directly to a suitable harbor on its own nearby coast for subsequent use. What is the status of the iceberg before, during, and after this adventure?

While floating freely on the high seas, apparently unencumbered by any obvious claiming marks or devices, the berg appears to be simply an object in and of the water column. Potentially dangerous and obstructive, it is owned by no one in particular and is available for use and/or abuse by anyone so inclined. In this guise, and more particularly as a hazard to navigation, it might well be termed a "res nullius"--no one's thing--because no one will acknowledge any responsibility or liability for the berg.

When the vessel comes along, discovers the berg, and takes it in tow, thereby exerting effective control over it, that vessel (and, derivatively, its master and owners), becomes responsible for the object now in its possession. This new possession may have had no value, or even a negative value, when it was first acquired out at sea, but as it was brought into port, it had an enhanced real resource value, e.g., as an accessible source of fresh water supply, inter alia. This change in net value with a change in location represents a "value added" by the diligent efforts of the vessel. If the user-state's government, as derivative owner of the berg through the vessel, chooses to distribute freely the products of this venture, then the berg might be termed a "free good,"

a general community resource, a "res communis" accessible to all. If a fee is charged for the iceberg-derived products and services, i.e., water, refrigeration, souvenirs, et al., then that money will go to the berg's possessors as reward and recompense for the time and effort and expenses involved in transporting (and perhaps processing) the berg.

Note that the government will not have sustained any expense for an initial purchase of the berg since the acquisition per se was free, even though the subsequent transport was presumably costly.

Of particular importance is the fact that, as an arm of government, the towing vessel asserted, in sequence, both ownership and jurisdiction over the berg. These are critical points which will arise again in a later section, so we will discuss them in some detail here.

Ownership may be said to have commenced when the vessel took uncontested possession of the berg on the high seas and subsequently exercised effective control over it, in this case both physically and proprietarily. If the vessel had merely towed the berg a short distance, intending only to remove it from busy sea lanes, and then abandoned it, the control (and liability) would be only physical, not proprietary, and soon relinquished.

So far, this is directly analogous to the accepted method by which a state would claim dominion over newly-discovered territory, "terra nullius." Indeed, the two procedures are historically related;

"...the international rules relating to territory are still in essentials the Roman rules of property."⁴⁶

Under more recent law,⁴⁷ the freedom of the high seas has meant

"that each and every state was recognized in law to have an equal right to navigate upon and to exploit the high seas right up to the edge of the territorial sea; and they possessed this right not jointly but severally, each one having the same unrestricted right of use and enjoyment."⁴⁸ (emphasis added)

The commencement of governmental jurisdiction is not as clearcut as that of ownership. There can be little doubt that jurisdiction would be recognized internationally via the principles of lex loci and lex fori when the towing entourage entered the possessor state's territorial water.⁴⁹ There may, however, be some question as to whether jurisdiction also applied during the berg's passage through any extra-territorial marine zones of the state. This would depend on both the domestic legislation establishing the purposes of such extra-territorial zones (e.g., fiscal, sanitary, pollution control) and the international recognition, or lack of same, accorded to that domestic legislation.

For example, a 200-mile exclusive economic zone claimed by a coastal state to restrict the exploitation of resources of its continental shelf would not apply directly to an iceberg because, as we shall see later, the iceberg is not a resource or even a product of the continental shelf.

Some people might argue that jurisdiction can begin even earlier, on the high seas, either through constructive assimilation into the identity of the towing vessel, or through principles of lex ferenda, that is, once possession is established in an area such as the high seas which is, by definition,⁵⁰ not subject to the sovereign lex loci jurisdiction of any nation, then that country of which the berg's possessor is a subject may also extend its protection and jurisdiction to cover the property of that individual or entity, e.g., an iceberg in tow.

Lest this last-mentioned point seem too outlandish, we can cite a single* iceberg-related precedent, the case of U.S. vs. Escamilla (467 F. 2nd 341, 1972), in which U.S. jurisdiction was claimed and pursued for an alleged crime committed on a large iceberg on the high seas.

It is recognized that the distinctions between criminal and civil jurisdiction are by no means insignificant, yet both are essentially domestic in nature (piracy notwithstanding). If domestic jurisdiction may be extended for one purpose, then perhaps it may be also extended for other purposes in a series of "creeping jurisdictions."

With regard to the Escamilla case, Bishop⁵¹ writes:

It is not clear whether the trial court regarded Fletcher's Ice Island as the equivalent of a "vessel" owned by the United States; the stronger basis for jurisdiction would appear to be that it was undoubtedly part of the "high seas." Doubts are increased about the case, since the appellate court split three for three on the jurisdictional point, but sent the case back for new trial because of errors

*As an illustration of the paucity of precedents, consider that the distinguished panelists and audience of international lawyers and polar scientists, from many nations and with many years' experience in all phases of polar activities, that were assembled for the First International Conference on Iceberg Utilization (Ames, Iowa, USA, Oct. 2-6, 1977), upon direct questioning, could think of no other instance in which the question of jurisdiction over an iceberg was actually presented, even tangentially, before a court for a clear ruling. This author's further efforts in this regard were equally fruitless.

in the charge to the jury. Escamilla was acquitted on retrial, leaving us with no definitive ruling on the jurisdiction question. The case at least suggests the possibility that an iceberg being towed by an American vessel might be regarded as a "vessel," or at least within United States criminal jurisdiction while on the high seas. (emphasis added.)

The question of whether or not an iceberg may be treated as a "vessel" is of major importance. Early resolution of this question is most strongly urged when we realize that, among the many iceberg utilization schemes proposed and in preparation, several would employ self-propelled icebergs.⁵² These would definitely require a direct attribution of status and not a derived status dependent on the presence and character of a separate towing vessel.

Since there is no international legal definition of a "vessel"⁵³, it would appear that this could be a matter for domestic legislation. Under the 1958 Convention on the High Seas,⁵⁴ "every state, whether coastal or not, has the right to sail ships under its flag on the high seas" (Article 4), may "fix the conditions for the grant of its nationality," (Article 5) and "shall take such measures for ships under its flag as are necessary...with regard inter alia to: ... (c) The construction, equipment and seaworthiness of ships" (Article 10) (emphasis added). Title 1, Section 3 of the United States Code declares that in our domestic statutes, "the word 'vessel' includes every description of water craft or other artificial contrivance used, or capable of being used, as a means of transportation on water."

Admiralty courts have argued at great length on this point and have on occasion given "vessel" status to a number of usual floating objects.⁵⁵

The fact that an iceberg is to be used itself, rather than to transport something else, might not be controlling if we recall that even rafts of logs have been treated as vessel status.⁵⁶

More directly, Prof. Pharand⁵⁷ suggests that ice islands should be treated as "ships when occupied and appropriated."

Ultimately, if an enterprising sovereign state chooses to support an iceberg transport venture by bestowing vessel status and nationality on any icebergs so acquired, it could do so and let the rest of the world make any accommodations felt to be necessary or desirable.

This approach may hardly be the most desirable one, yet it is indeed possible.

The attractiveness of treating an acquired iceberg as a vessel should be readily apparent to domestic legislators and administrators concerned with expedience. By adopting this stance, they could take fully half of

the emerging problems of icebergs, i.e., the post-acquisitional concerns, and pass these problems on to an existing body of well-established laws, precedents, and institutional arrangements.

This would leave only those substantive questions dealing with iceberg status before acquisition, and those procedural questions pertaining to how acquisition is to be conducted and recognized. We shall address these points in a moment.

Absent a finding that icebergs shall be treated as vessels, and discerning no other similarly all-encompassing status, jurists would eventually have to delineate de novo the status of icebergs in relation to the full range of marine concerns, including rights of "innocent passage," flag nationality, sea lanes, limitation of liability statutes, and rights and remedies of seamen, owners, lienors, insurers, etc.

In the eyes of potential iceberg users, the questions are certainly clear, but the answers are clearly uncertain.

Having thus explored the post-acquisitional phase, we will now turn to the questions of the status of icebergs before such acquisition.

The ice shelves previously described are attached to and form a surface continuous with the mainland, partly touching bottom and partly afloat. This leads to a novel situation. In the words of one authority: "A more or less land-locked ice-cap in firm union with the bedrock beneath it is...for all practical purposes...as perpetually solid as the land it binds together and sits on. What industries or actions of the high seas can be exercised on and in such a medium? Whether certain portions of Antarctica are shown to be only islands bound together by solid ice or land depressed by the great weight of the ice, it would seem proper to modify the concept of territory to accommodate such glacies firma."⁵⁸

Consider also that "...the complications for international law are numerous when it must be conceded that thousands of square miles of interior Antarctic surface are in reality ten-thousand feet of rigid ice over rock that is well below sea level."⁵⁹ (emphasis added.)

Numerous commentators⁶⁰ have supported the thought that Antarctic ice shelves "should be regarded as land and can be the object of sovereignty"; "must be put on a par with land territory, and...can be occupied"; and "can be subjected to sovereignty." Objections in the literature to such a parity of ice and land are almost entirely stated in relation to the sea ice situation at the North Pole, which is fundamentally different in several essentials, e.g., origins as pack ice, in constant motion, without attachment to land either above or below sea level.⁶¹

More to the point, states have always acted toward Antarctica as if it had been land,⁶² and this customary practice is reflected in the language used in the Antarctic Treaty of 1959,⁶³ which de-limits the territorial extent of the treaty as "the area south of 60° South Latitude, including all ice shelves." (Article 6)

This language "certainly assimilates ice shelves to the area of Antarctica and therefore presumably to a land status."⁶⁴ From this land status it clearly follows that any baselines to be drawn for the purpose of calculating a territorial sea would oftentimes be drawn on the calving face of an ice shelf.

At this point, pause to consider a basic question that has been implicit in much of the previous discussion: Who can legitimately authorize or prohibit the use of the iceberg resources of Antarctica?

Legitimate civil authority is usually based on territorial sovereignty. As Jessups has noted, "a claim with...reference to waters adjacent to the Antarctic continent must find basic support in the maintenance of a claim to sovereignty over the land itself."⁶⁵ And Lundquist comments:

Unfortunately, the legal status of territorial claims in Antarctica is very much an unresolved question. Consequently, no inquiry can culminate in a precise legal definition of iceberg property rights.⁶⁶

Indeed, the whole question of resource exploitation is conspicuously absent in the Antarctic Treaty regime. Nevertheless, some points are clear. Any state claiming territorial sovereignty in a sector of Antarctica is not at all likely to allow anyone to come into that sector and remove an exposed portion of an attached ice shelf, because this would not only retract the landward baseline used for calculating their claim's derivative territorial sea, but would also be equivalent to, and in fact identical with, removing a part of their territory itself.

If icebergs are to be harvested within a claimed sector of the Antarctic Treaty area, they will be taken only after calving, while afloat in the water column, and any harvesters working near this coast will be subject to the claimant state's domestic regulations pertaining to territorial and extra-territorial seas there.

If, however, iceberg harvesters are in an unclaimed sector--terra nullius--then so too the ice there will be res nullius and available for harvesting irrespective of any landward attachment.

Yet it may be unnecessary even to consider iceberg harvesting operations within the scope of the Antarctic Treaty area at all, for icebergs of suitable dimensions are regularly seen on the high seas as far north as

40°S in the South Atlantic and Indian Oceans, and to 50°S in the South Pacific Ocean.⁶⁷ The nascent stage of iceberg utilization likely in the near future will certainly not exhaust the many hundreds of square miles of ice freely accessible on the high seas here.

No doubt a series of trial programs will be necessary to help determine whether icebergs have real practical value. If they can pass the tests of economics and engineering, then the legal considerations mentioned herein will be addressed in due time and appropriate arrangements under international law will evolve to deal with this challenging new resource opportunity. These thoughts are, therefore, offered with the realization that "legislation in international relations, as in municipal law, is easier when the future can be envisaged, but before vested interests are established."⁶⁸

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